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Sequences of dry days in S.W. Scotland within the three month period May to July (inclusive)

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The following notes may be of some general interest in relation to certain agricultural operations.

1. Although year to year experience of dry days can differ appreciably between sites within a region such as south west Scotland, long period expectations may be satisfactorily indicated by a study of data for an extended period at but one or two stations within the region. Accordingly attention was focused upon data from,

Auchincruive (nr Ayr) 147 feet above MSL., annual rainfall 39.44 ins and period 1936-71

and Dumfries 140 feet above MSL., annual rainfall 42.79 ins and period 1921-1971.

A dry day was defined as one in which no measurable rainfall was reported (i.e. less than 0.01 in in 24 hours), traces were accordingly ignored as were any days on which high humidity (e.g. as from sea fog or "haar") might have occurred. A fall of 0.01 inch or so in 24 hours is a very small amount and particularly in the summer months may well be of no consequence in relation to outside activities. However by accepting such days with very low rainfall as non-dry some implicit allowance is made for the neglect of other days on which excessively high humidity and general dampness occur, but do not give rise to any deposit in the rain-gauge.

2. It has been frequently noted that on average, once two or three successive days have been dry, there is a fairly constant probability of the dry spell extending to a further day viz. if N spells of at least three successive dry

days have occurred then the number of spells of at least 4, 5, 6 etc days are given by:

$$N_p \quad N_p^2 \quad N_p^3$$

or more generally $N_p^{(n-3)}$ where n is the length of the spell. The typical values of p for much of the British Isles range between about 0.65 and 0.80(+), and is certainly greater than the ratio:

$$\frac{\text{No of dry days in period}}{\text{Total number of days in period}}$$

The value of p expresses statistically the fact that atmospheric circulation in Scotland (and indeed generally) is such that days of like character tend to cluster and occur in sequences, rather than completely at random.

When examining the data, the character of days immediately prior to May 1 and subsequent to July 31 were ignored i.e. daily contributions to dry spells extending outside the period were not taken into account.

The number of dry spells of exactly one, two, three etc days were first extracted; as an example we note that at Dumfries in 1932 the total number of dry days occurred in the following groups:

6 individual separate days

4 groups of 2 days each

2 groups of 3 days each

1 group of 5 days each

1 group of 26 days (this was the longest spell reported in the whole series)

These were next accumulated in the form of:

14 spells of at least 1 day

8 " " " " 2 days

4 " " " " 3 days

(4 " " " " 4 days)

2 " " " " 5 days

(1 " " " " 6 days)

(and so on to)

1 spell of at least 26 days

The above mentioned season which occurred in 1932 was not typical and in general there was a much smoother transition in the decrease in number of spells as spell length increased.

The complete period was divided in two roughly equal sub-periods and average values of spell frequencies for the sub-periods and complete periods examined. The details are set out in Figs 1 and 2 from which it is clear that both sub-samples were similar to each other and could be reasonably amalgamated. Taking into account both the individual values of p derived from successive cumulative frequencies and the "best" eye-fitted straight line, the average values of "p" were:

Auchincruive $p = 0.71$

Dumfries $p = 0.75$

On this average basis p remained fairly constant up to spells of 15 days or so, beyond which it fell rather rapidly, except for individual years (at Dumfries) where, if the spell lasted for 18 days or so, it tended to persist for an additional period of several days. There is also a suggestion in both graphs that the probability p tends to increase (to values exceeding 0.80) temporarily once a spell of 8 to 10 days has become established.

3. Although of considerable general interest, average values for an extended period may not be an informative for practical purposes as data describing the behaviour of individual "seasons".

Some data on these bases now follow:

(a) "Years" (i.e. May-July period) on which spells of or exceeding certain duration did not occur.

Dumfries (D) (1921-71): and Auchincruive (A) (1936-71)

No spells of 5 or more dry days:-

(D) 1924, '31, '37, '45, '47.

(A) '45, '47, '56.

No spells of 7 or more dry days:-

Years listed above plus

(D) 1956, '58

(A) 1940, '58, '63, '66

No spells of 10 or more dry days

Years listed above plus

(D) 1922, '27, '28, '33, '44, '48, '50, '54, '63, '64, '65, '66, '70

(A) 1937, '38, '41, '44, '48, '50, '54, '60, '64, '65.

In view of the current interest in the deficiency of rainfall in the second half of 1972, the following information may be of value:- During May-July period, spells of 5 or more dry days were limited to one of 8 days at Dumfries and two of 7 days at Auchincruive. During the dry second half of the year, dry spells of 5 or more days were comprised as follows:

Dumfries one of 7 days, one of 10 days and one of 13 and one of 17 days.

and Auchincruive one of 6 days, two of 10 days and one of 14 days.

(b) Years in which a stated number of "dry" days occurred within spells of at least 5 days (i.e. a "dry day" is discounted unless it occurred in a spell of 5 or more such days).

Days	0	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36
				Dumfries (1921-'71)					
Frequency	5	1	1	7	11	12	9	3	2
				Auchincruive (1936-'71)					
Frequency	3	1	3	10	5	8	5	1	0

Thus at Dumfries there were 7 years in which (during May-July) between 11 and 15 dry days occurred in clusters of at least 5 days together. The highest value at the two stations were made up as under:

Dumfries: (36 days)

1921 two spells of 5 days, one of 6, one of 7, and one of 13

1957 one spell of 6 days, one of 13, and one of 17

Auchincruive: (31 days)

1955, one of 6, one of 9 and one of 16

At Auchincruive in 1957, 27 "dry" days were reported made up of:

one spell of 11 days and one of 16 days

similarly, at Dumfries in 1955, the total number of "dry" days i.e. 33 were composed of:

one spell of 10 days and one of 23 days.

A plot of the sequence of such "dry" days confirmed that notably high and low totals occurred simultaneously at both places. It was also apparent that from 1959 to 1971 values for both places lay between 10 and 30 days, furthermore values ranged between comparatively narrow limits within the period 1948 to 1954. Wide year to year variations were clearly evident between 1955 and 1958 and prior to 1948.

FIG 1 Dumfries (Period; May – July)

1922–1946
1947–1971
1922–1971
Line of best fit ("by eye")

Number of spells of at least n dry days

Number (n) of successive dry days.

(13)
(23)
26

No. 9L. LOGARITHMIC x 10THS (3 CYCLE)

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FIG 2 Auchincruive (Ayr) Period. May–July.

1936–1951
1952–1971
1936–1971
Line of best fit (by eye)

Number of spells of at least n dry days.

Number (n) of successive dry days.

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